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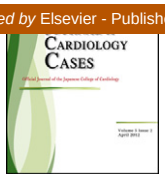

Case Report

Marked improvement of renal failure and severe hypertension after renal artery stenting in the solitary functioning kidney

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ABSTRACT

Atherosclerotic renal artery stenosis (ARAS) can cause resistant hypertension, progressive renal failure and/or cardiorenal syndrome. Although no randomized study to demonstrate the superiority of renal stenting over medical treatment is available, a case-sensitive approach is required for the treatment of ARAS. Here, we describe a case report of a symptomatic ARAS patient with a solitary functioning kidney in which successful detection of ARAS by ultrasonography examination with the Doppler method and timely renal artery stenting were performed.

<Learning objective: The clinical efficacy of renal artery stenting for symptomatic ARAS as a method of lowering blood pressure and preventing deterioration in renal function remains unproven. However, renal artery stenting performed based on enough investigation of clinical course and information by ultrasonography examination with Doppler method results in benefit to the patient with ARAS.>

Introduction

Renovascular hypertension due to atherosclerotic renal artery stenosis (ARAS) is a major cause of secondary hypertension, and is often severe or resistant to treatment. This hypertension is progressive and causes ischemic nephropathy or renal failure [1]. The STAR and ASTRAL trials, which compared drug treatment and revascularization, showed no superiority of revascularization to drug treatment in terms of the preservation of renal function, blood pressure control, and effects on cardiovascular events [2,3]. However, these studies involved limitations regarding patient enrollments. Thus, a case-sensitive approach is required for the treatment of ARAS. There have been many studies on factors predicting the effects of revascularization [4–7]. We report an ARAS patient with a solitary functioning kidney that was successfully detected by ultrasonography examination with the Doppler method and who was treated by renal artery stenting.

Case report

A 57-year-old female with past history of coronary angioplasty had been treated for hypertension for 10 years, but its control had been poor. In December 2009, she was admitted to our hospital due to acute heart failure by cardiorenal syndrome. The serum creatinine level was 1.3 mg/dl [estimated glomerular filtration rate (eGFR): 33.7 ml/min/1.73 m^2]. For the poorly controlled hypertension, three antihypertensive agents, nifedipine CR (40 mg/day), cilnidipine (10 mg/day), and valsartan (80 mg/day), were administered, but her blood pressure remained at 160–170/80–90 mmHg.

Secondary hypertension was suspected for her refractory hypertension, and various examinations were performed. Plasma renin activity was 4 ng/ml/h (normal range: 0.8–2.0 ng/ml/h) and aldosterone concentration was 105 pg/ml (normal range: 30–160 pg/ml). Renal artery ultrasonography examination with the Doppler method revealed the atrophic left kidney with complete obstruction of the renal artery. In the right kidney, ultrasonography examination with the Doppler method revealed that the peak systolic velocity was 204 cm/s, renal to aortic ratio was 3.6, and acceleration time was 120 ms, and these measured values that increased suggested severe stenosis of right renal artery. The resistive index was normal (0.65). Renograms showed that the left kidney was non-functional kidney and the function of right kidney

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decreased. She was discharged after having been treated for heart failure, and treated with the above anti-hypertensive drugs at an outpatient clinic. However, her blood pressure control remained poor, and the serum creatinine level began to gradually increase in May 2010, reaching 2.39 mg/dl in July. Since uremia developed, she was admitted on July 14, 2010 again.

On admission, her blood pressure was 201/100 mmHg, and the serum creatinine level increased to 3.21 mg/dl (eGFR: 12.5 ml/min/1.73 m^2). B-type natriuretic peptide (BNP) level was 750 pg/ml. On July 21, selective renal artery angiography showed a severe stenotic lesion from the ostium to the middle portion of the right renal artery (Fig. 1A). A Palmaz Genesis 4.0 mm × 18 mm stent (Cordis Corp., Bridgewater, NJ, USA) was deployed after pre-dilatation (Fig. 1B). A device for distal protection was not used, however, there were no complications such as peripheral embolism, and only 20 ml of contrast agent were used.

The preoperative urine volume was 400–500 ml/day, which markedly increased immediately after the revascularization to 2500 ml/day. The systolic blood pressure decreased to 100–130 mmHg the next day (Fig. 2). The serum creatinine level decreased to 2.07 mg/dl after 1 week. Although the doses of the anti-hypertensive drugs could not be reduced, the systolic blood pressure measured at the outpatient clinic became stable in the range of 130–140 mmHg. The serum creatinine level continued to gradually improve after discharge, and decreased to 1.09 mg/dl in December 2010, 5 months after the revascularization (Fig. 3).

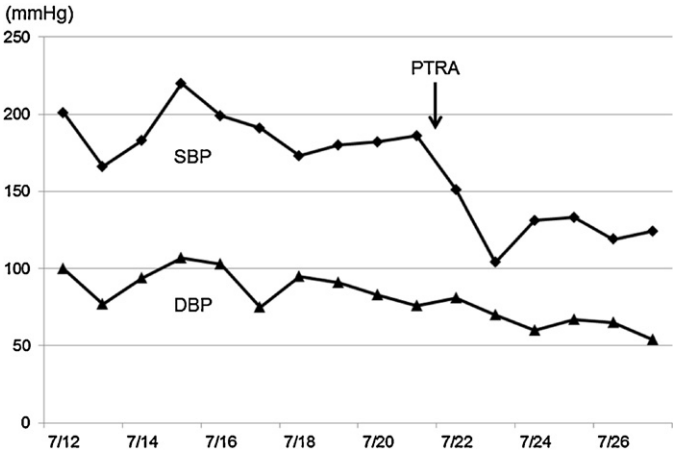

Fig. 2. Blood pressure dramatically improved after renal artery revascularization. PTRA, percutaneous transluminal renal angioplasty; SBP, systolic blood pressure; DBP, diastolic blood pressure.

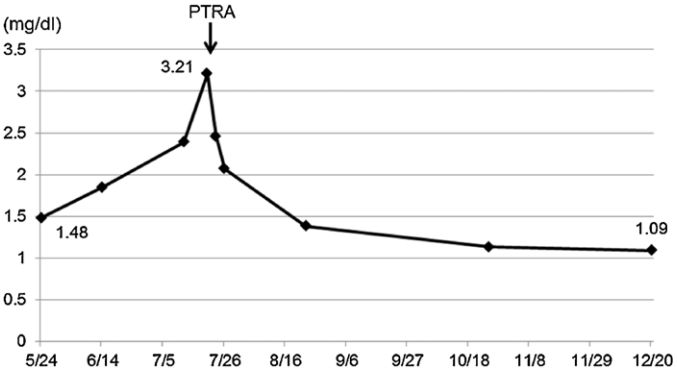

Fig. 3. Serum creatinine level dramatically improved after renal artery revascularization. PTRA, percutaneous transluminal renal angioplasty.

Discussion

In this patient, there were the following 4 important points: (1) Renal artery stenting resulted in marked improvement in renal function and blood pressure. (2) Despite the presence of renal artery stenosis, the values of renin activity and aldosterone were almost in the normal range. (3) On the evaluation for renal artery stenosis and the prediction of the effects of revascularization, renal artery ultrasonography examination with the Doppler method was useful. (4) Renal artery stenting was performed in this case with a solitary functioning kidney.

Improvement in renal function and blood pressure

Many previous reports showed that 8–51% of patients who underwent renal artery revascularization were categorized as having improved renal function and up to 31% had worsened renal function [8], therefore improvement in renal function by renal artery revascularization has been controversial. We will discuss factors predicting an improvement in renal function below. With regard to blood pressure, there are several reports that an anti-hypertensive effect of renal artery revascularization is achieved in many cases [9], and that pre-interventional BNP and translesional pressure gradient may be helpful to identify patients in whom renal angioplasty will improve blood pressure [10,11]. However, it is difficult to get complete normalization of blood pressure, and in this case, the doses of the anti-hypertensive drugs could not be reduced.

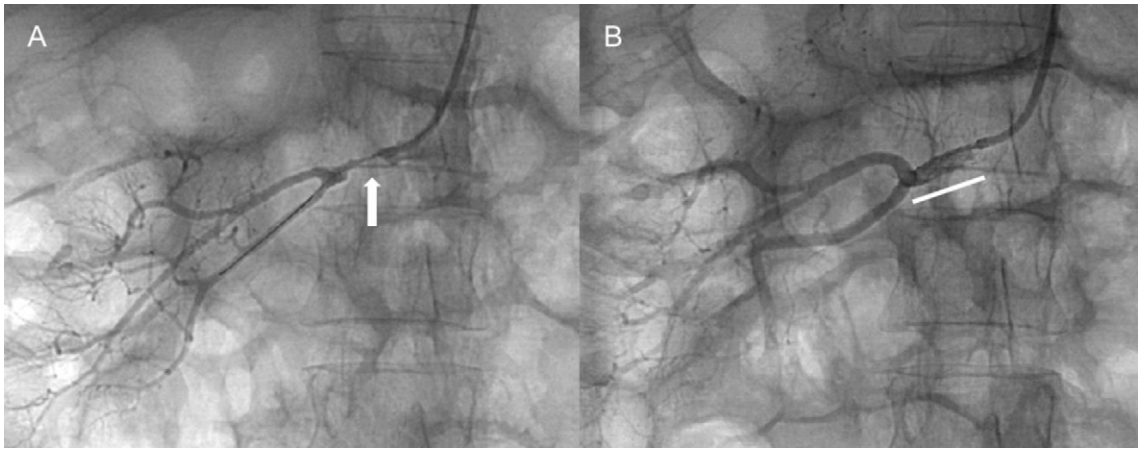

Fig. 1. (A) Pre-procedural right renal artery angiogram. White arrow shows the severe stenosis. (B) Angiogram after stenting. White bar shows implanted stent.

Evaluation for renin activity and aldosterone

Generally, renin activity in the peripheral blood should be increased in renovascular hypertension. However, in this case, since renal blood flow was markedly decreased due to complete obstruction of the left renal artery and severe stenosis in the right renal artery, the main cause of hypertension observed before renal angioplasty may have been a volume overload. The renin–angiotensin system before renal angioplasty may have been rather inhibited because of negative feedback by volume overload, resulting in no increase in these measurements. Therefore, values of renin activity and aldosterone may not be related to indication of renal angioplasty. With increase of urine output after renal angioplasty, her body weight decreased by 5 kg in 1 week. Plasma renin activity was 6.5 ng/ml/h and aldosterone concentration was 282 pg/ml 1 week after renal angioplasty.

Usefulness of ultrasonography examination with Doppler method and prediction of renal function improvement

For the detection of renal artery stenosis, both the sensitivity and the specificity of contrast computed tomography are more than 90% [12]. However, in patients such as this one with renal dysfunction, this method is difficult because of concern about contrast-induced nephropathy. Renal artery ultrasonography examination with the Doppler method is noninvasive and useful for morphological and functional diagnosis, and should be actively performed in patients with suspected renal artery stenosis. This method is also recommended by American Heart Association/American College of Cardiology (AHA/ACC) guidelines [13]. In addition to the diagnostic usefulness, this provides important information on whether the preserving effects of renal angioplasty can be expected. Based on various previous studies [4–7], in the presence of the following factors, renal angioplasty is expected to exert preserving effects on the renal function: (1) proteinuria, <1 g/day; (2) creatinine level, <3.0–4.0 mg/dl; (3) progressive renal dysfunction; (4) absence of renal atrophy (long axis $\geq$ 7 cm); and (5) resistive index of the interlobar artery, <0.8. The latter two factors can be evaluated by ultrasonography. In this patient, the preoperative serum creatinine level was high (3.21 mg/dl), but proteinuria was absent, and progressive renal dysfunction was observed. In addition, ultrasonography showed the absence of right kidney atrophy and a resistive index of the interlobar artery of 0.65. These findings suggested that the renal function can be improved by renal angioplasty. However, there is a report that a resistive index is not a predictor of improvement of renal function [14], and we should decide the utility of resistive index depending on an individual case.

Renal artery stenting in case with a solitary functioning kidney

This case presented with a solitary functioning kidney, therefore, if complications occurred at renal angioplasty, severe renal failure may have occurred. However, Davies et al. reported that renal artery stenting can be performed safely when the contralateral kidney is not only normal but also non-functional [15]. In particular, with the appearance of renal artery stents, this technique has been reported to be superior to balloon dilatation alone in terms of both the success and the restenosis rates [16].

Previous randomized studies [9,17,18] included patients treated by only balloon dilatation as well as patients treated by stent implantation, therefore, superiority of stent implantation over medical treatment alone were not evaluated precisely. However, after detailed evaluation of the clinical background and findings of ultrasonography examination with the Doppler method, patients in whom renal artery stenting is indicated can be selected. AHA/ACC guidelines highly recommended renal stenting for symptomatic ARAS with a solitary functioning kidney [13].

In this case, elevation of plasma renin activity and aldosterone concentration after renal angioplasty was revealed. Some previous reports showed that renin and aldosterone were secreted even by an atrophied kidney, and renal venous blood sampling could be used as a predictive test for revascularization or surgically correctable renal disease when the ischemic and atrophied kidney has a significantly higher venous plasma renin activity than the normal kidney [19–21]. When blood pressure control becomes difficult using drug administration alone, an increase in renin secretion should be confirmed by renal venous blood sampling, and revascularization of the completely obstructed renal artery or nephrectomy should be considered. Nagata et al. reported a patient in whom an increase in renin secretion from an atrophied kidney was confirmed, and revascularization for a completely obstructed renal artery succeeded, achieving favorable blood pressure control [20].

Conclusion

This case reported the successful management of an ARAS patient with a solitary functioning kidney. Besides early identification of ARAS by ultrasonography examination with the Doppler method, timely renal artery stenting tailored to the patient could contribute to clinical success.

Disclosures

None.

References

[1] Safian RD, Textor SC. Renal-artery stenosis. N Engl J Med 2001;344:431–42.
[2] Bax L, Woittiez AJ, Kouwenberg HJ, Mali WP, Buskens E, Beek FJ, Braam B, Huysmans FT, Schultze Kool LJ, Rutten MJ, Doorenbos CJ, Aarts JC, Rabelink TJ, Plouin PF, Raynaud A, et al. Stent placement in patients with atherosclerotic renal artery stenosis and impaired renal function: a randomized trial. Ann Intern Med 2009;150:840–8.
[3] Wheatley K, Ives N, Gray R, Kalra PA, Moss JG, Baigent C, Carr S, Chalmers N, Eadington D, Hamilton G, Lipkin G, Nicholson A, Scoble J. Revascularization versus medical therapy for renal-artery stenosis. N Engl J Med 2009;361:1953–62.
[4] Muray S, Martin M, Amoedo ML, Garcia C, Jornet AR, Vera M, Oliveras A, Gomez X, Craver L, Real MI, Garcia L, Botey A, Montanya X, Fernandez E. Rapid decline in renal function reflects reversibility and predicts the outcome after angioplasty in renal artery stenosis. Am J Kidney Dis 2002;39:60–6.
[5] Beutler JJ, Van Ampting JM, Van De Ven PJ, Koomans HA, Beek FJ, Woittiez AJ, Mali WP. Long-term effects of arterial stenting on kidney function for patients with ostial atherosclerotic renal artery stenosis and renal insufficiency. J Am Soc Nephrol 2001;12:1475–81.
[6] Campo A, Boero R, Stratta P, Quarello F. Selective stenting and the course of atherosclerotic renovascular nephropathy. J Nephrol 2002;15:525–9.
[7] Radermacher J, Chavan A, Bleck J, Vitzthum A, Stoess B, Gebel MJ, Galanski M, Koch KM, Haller H. Use of Doppler ultrasonography to predict the outcome of therapy for renal-artery stenosis. N Engl J Med 2001;344:410–7.
[8] Balk E, Raman G, Chung M, Ip S, Tatsioni A, Alonso A, Chew P, Gilbert SJ, Lau J. Effectiveness of management strategies for renal artery stenosis: a systematic review. Ann Intern Med 2006;145:901–12.
[9] Plouin PF, Chatellier G, Darne B, Raynaud A. Blood pressure outcome of angioplasty in atherosclerotic renal artery stenosis: a randomized trial, Essai Multicentrique Medicaments vs Angioplastie (EMMA) Study Group. Hypertension 1998;31:823–9.
[10] Staub D, Zeller T, Trenk D, Maushart C, Uthoff H, Breidthardt T, Klima T, Aschwanden M, Socrates T, Arenja N, Twerenbold R, Rastan A, Sixt S, Jacob AL, Jaeger KA, et al. Use of B-type natriuretic peptide to predict blood pressure improvement after percutaneous revascularisation for renal artery stenosis. Eur J Vasc Endovasc Surg 2010;40:599–607.
[11] Leesar MA, Varma J, Shapira A, Fahsah I, Raza ST, Elghoul Z, Leonard AC, Meganathan K, Ikram S. Prediction of hypertension improvement after stenting of renal artery stenosis: comparative accuracy of translesional pressure gradients, intravascular ultrasound, and angiography. J Am Coll Cardiol 2009;53:2363–71.
[12] Johnson PT, Halpern EJ, Kuszyk BS, Heath DG, Wechsler RJ, Nazarian LN, Gardiner GA, Levin DC, Fishman EK. Renal artery stenosis:

CT angiography—comparison of real-time volume-rendering and maximum intensity projection algorithms. Radiology 1999;211:337–43.
[13] Hirsch AT, Haskal ZJ, Hertzer NR, Bakal CW, Creager MA, Halperin JL, Hiratzka LF, Murphy WR, Olin JW, Puschett JB, Rosenfield KA, Sacks D, Stanley JC, Taylor Jr LM, White CJ, et al. ACC/AHA 2005 Practice Guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): a collaborative report from the American Association for Vascular Surgery/Society for Vascular Surgery, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (Writing Committee to Develop Guidelines for the Management of Patients With Peripheral Arterial Disease): endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. Circulation 2006;113: e463–654.
[14] Zeller T, Muller C, Frank U, Burgelin K, Horn B, Schwarzwalder U, Cook-Bruns N, Neumann FJ. Stent angioplasty of severe atherosclerotic ostial renal artery stenosis in patients with diabetes mellitus and nephrosclerosis. Catheter Cardiovasc Interv 2003;58:510–5.
[15] Davies MG, Saad WE, Bismuth JX, Naoum JJ, Peden EK, Lumsden AB. Endovascular revascularization of renal artery stenosis in the solitary functioning kidney. J Vasc Surg 2009;49:953–60.
[16] Leertouwer TC, Gussenhoven EJ, Bosch JL, van Jaarsveld BC, van Dijk LC, Deinum J, Man In't Veld AJ. Stent placement for renal arterial stenosis: where do we stand? A meta-analysis. Radiology 2000;216:78–85.
[17] Webster J, Marshall F, Abdalla M, Dominiczak A, Edwards R, Isles CG, Loose H, Main J, Padfield P, Russell IT, Walker B, Watson M, Wilkinson R. Randomised comparison of percutaneous angioplasty vs continued medical therapy for hypertensive patients with atheromatous renal artery stenosis. Scottish and Newcastle Renal Artery Stenosis Collaborative Group. J Hum Hypertens 1998;12:329–35.
[18] van Jaarsveld BC, Krijnen P, Pieterman H, Derkx FH, Deinum J, Postma CT, Dees A, Woittiez AJ, Bartelink AK, Man In't Veld AJ, Schalekamp MA. The effect of balloon angioplasty on hypertension in atherosclerotic renal-artery stenosis. Dutch Renal Artery Stenosis Intervention Cooperative Study Group. N Engl J Med 2000;342:1007–14.
[19] Alchi B, Shirasaki A, Narita I, Nishi S, Ueno M, Saeki T, Miyamura S, Gejyo F. Renovascular hypertension: a unique cause of unilateral focal segmental glomerulosclerosis. Hypertens Res 2006;29:203–7.
[20] Nagata Y, Taniguchi Y, Usuda K, Kawabata M, Iida H. Successful percutaneous revascularization in a patient with a chronic totally occluded renal artery in an atrophied kidney. Intern Med 2010;49:215–9.
[21] Rossi GP, Cesari M, Chiesura-Corona M, Miotto D, Semplicini A, Pessina AC. Renal vein renin measurements accurately identify renovascular hypertension caused by total occlusion of the renal artery. J Hypertens 2002;20:975–84.